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(54) **CONTENT ENGINE FOR MOBILE COMMUNICATIONS SYSTEMS**

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H04L 29/08 (2006.01)
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(52) **U.S. Cl.**
CPC ..... ***H04L 67/2823*** (2013.01); ***H04L 67/2814*** (2013.01); ***H04L 67/2842*** (2013.01); (Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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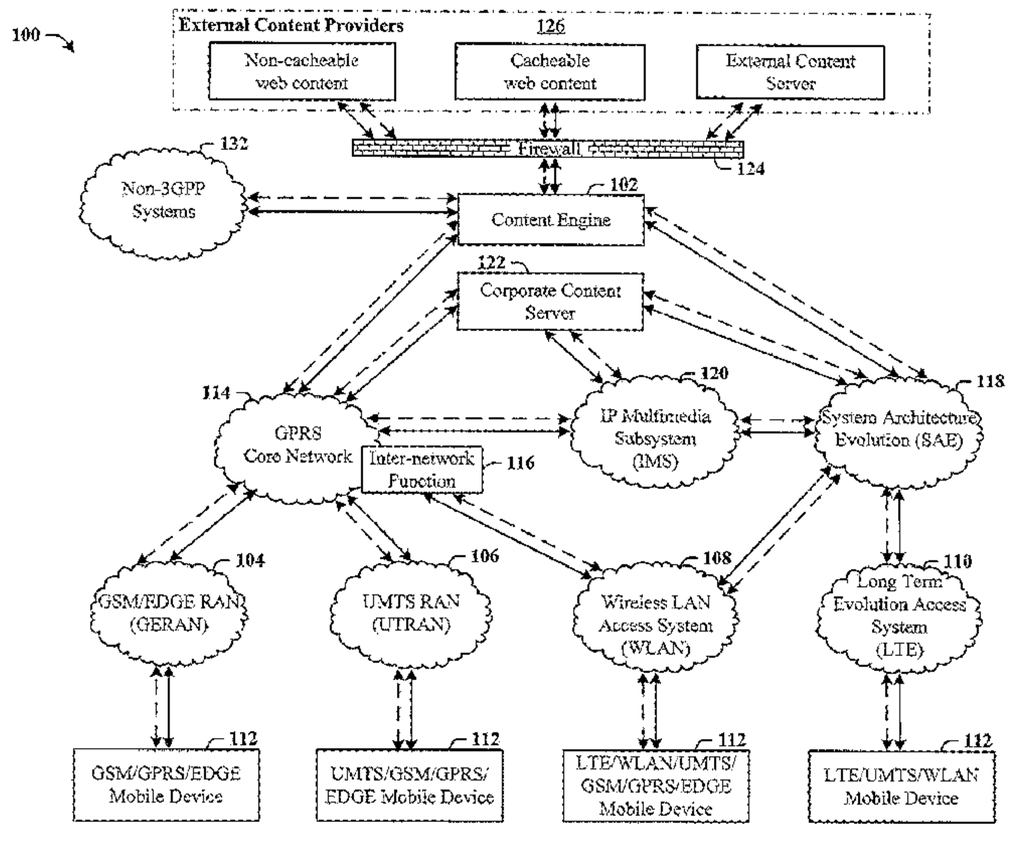
(57) **ABSTRACT**

An exemplary content engine includes a content gateway configured to analyze and route content requests to a content server. The content server can be a cache server or a mobile content server. The cache server can be configured to receive and store cacheable web content from a controller that is configured to receive the cacheable web content from at least one cacheable web content provider, such as a web server, and route the content to the cache server. The mobile content server can be configured to receive, from the controller, and store the digital media content. The controller can be further configured to receive the digital media content from at least one external content server and route the content to the mobile content server. The content gateway can be further configured to receive non-cacheable web content from at least one non-cacheable web content provider.

20 Claims, 3 Drawing Sheets



Related U.S. Application Data

continuation of application No. 12/791,414, filed on Jun. 1, 2010, now Pat. No. 9,270,775, which is a continuation of application No. 11/752,199, filed on May 22, 2007, now Pat. No. 7,756,130.

(52) **U.S. Cl.**
CPC ***H04L 67/34*** (2013.01); ***H04W 88/18*** (2013.01); *H04L 67/289* (2013.01)

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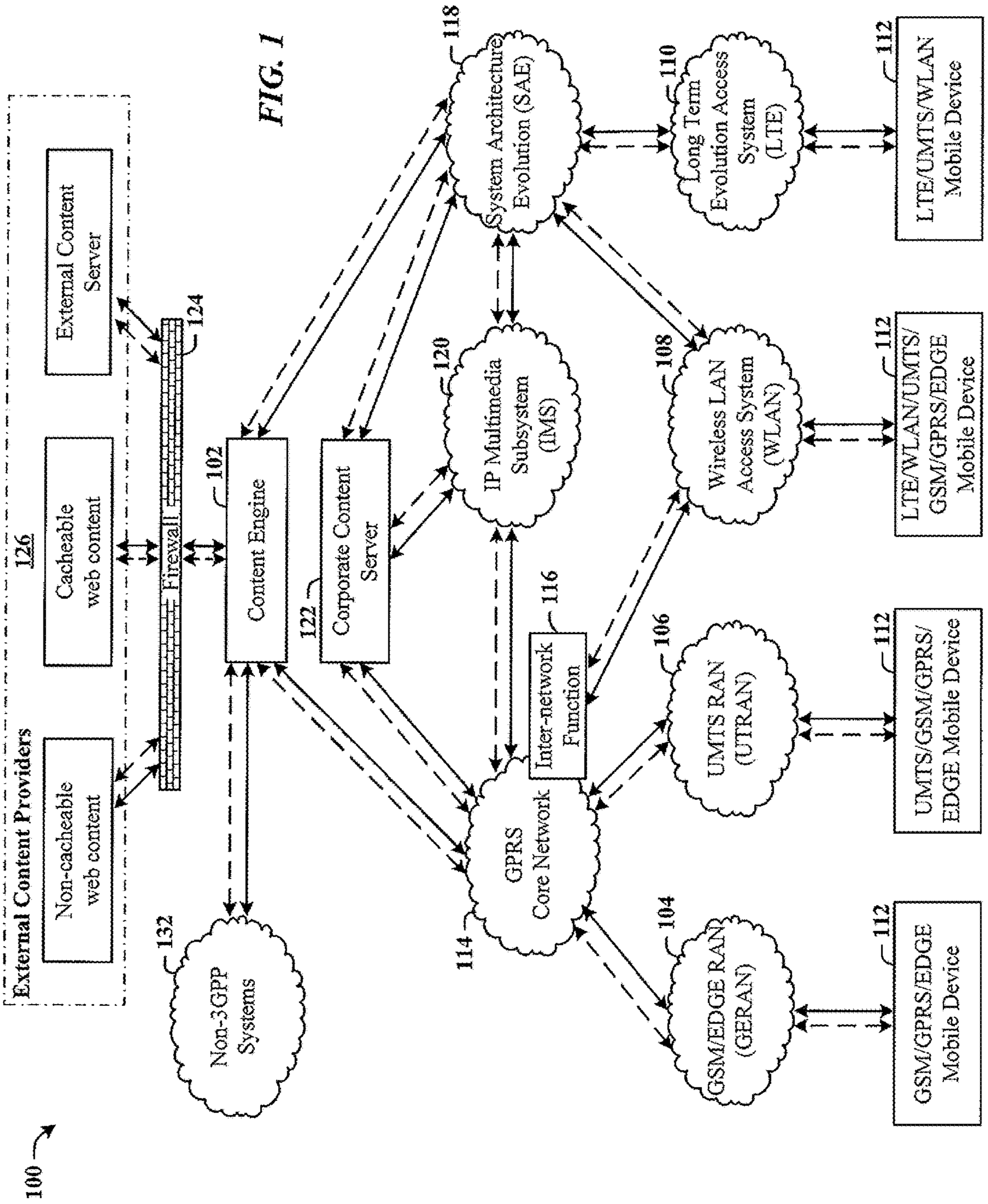
FIG. 1


100
118
System Architecture Evolution (SAE)
110
Long Term Evolution Access System (LTE)
112
LTE/UMTS/WLAN Mobile Device
126
External Content Providers
Non-cacheable web content
Cacheable web content
External Content Server
124
Firewall
102
Content Engine
122
Corporate Content Server
120
IP Multimedia Subsystem (IMS)
108
Wireless LAN Access System (WLAN)
LTE/WLAN/UMTS/GSM/GPRS/EDGE Mobile Device
116
Inter-network Function
106
UMTS RAN (UTRAN)
UMTS/GSM/GPRS/EDGE Mobile Device
GPRS Core Network
114
104
GSM/EDGE RAN (GERAN)
GSM/GPRS/EDGE Mobile Device
132
Non-3GPP Systems

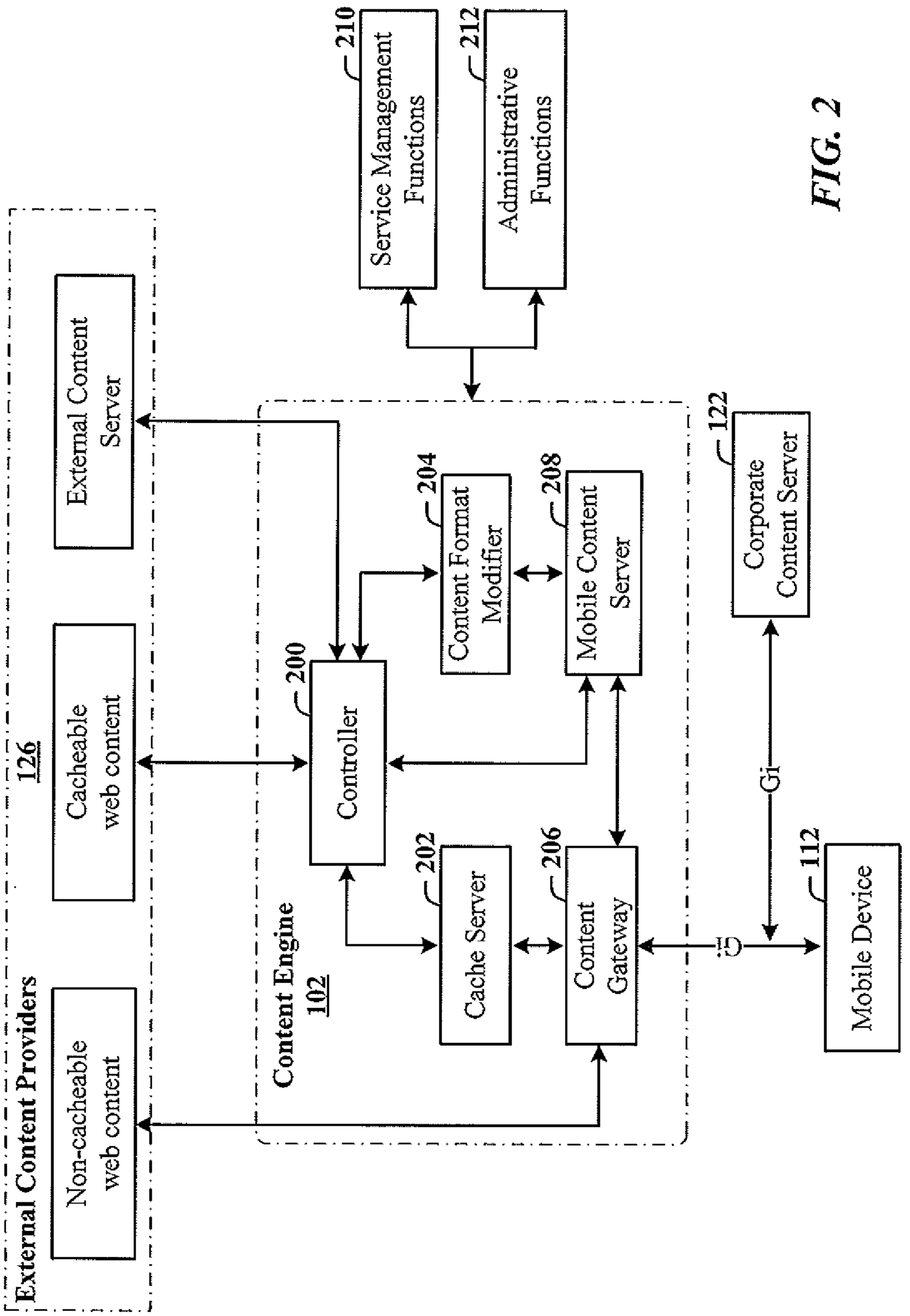

210
Service Management Functions
212
Administrative Functions
External Content Server
122
Corporate Content Server
126
Cacheable web content
200
Controller
204
Content Format Modifier
208
Mobile Content Server
Content Engine
102
202
Cache Server
206
Content Gateway
Gi
112
Mobile Device
External Content Providers
Non-cacheable web content

FIG. 2

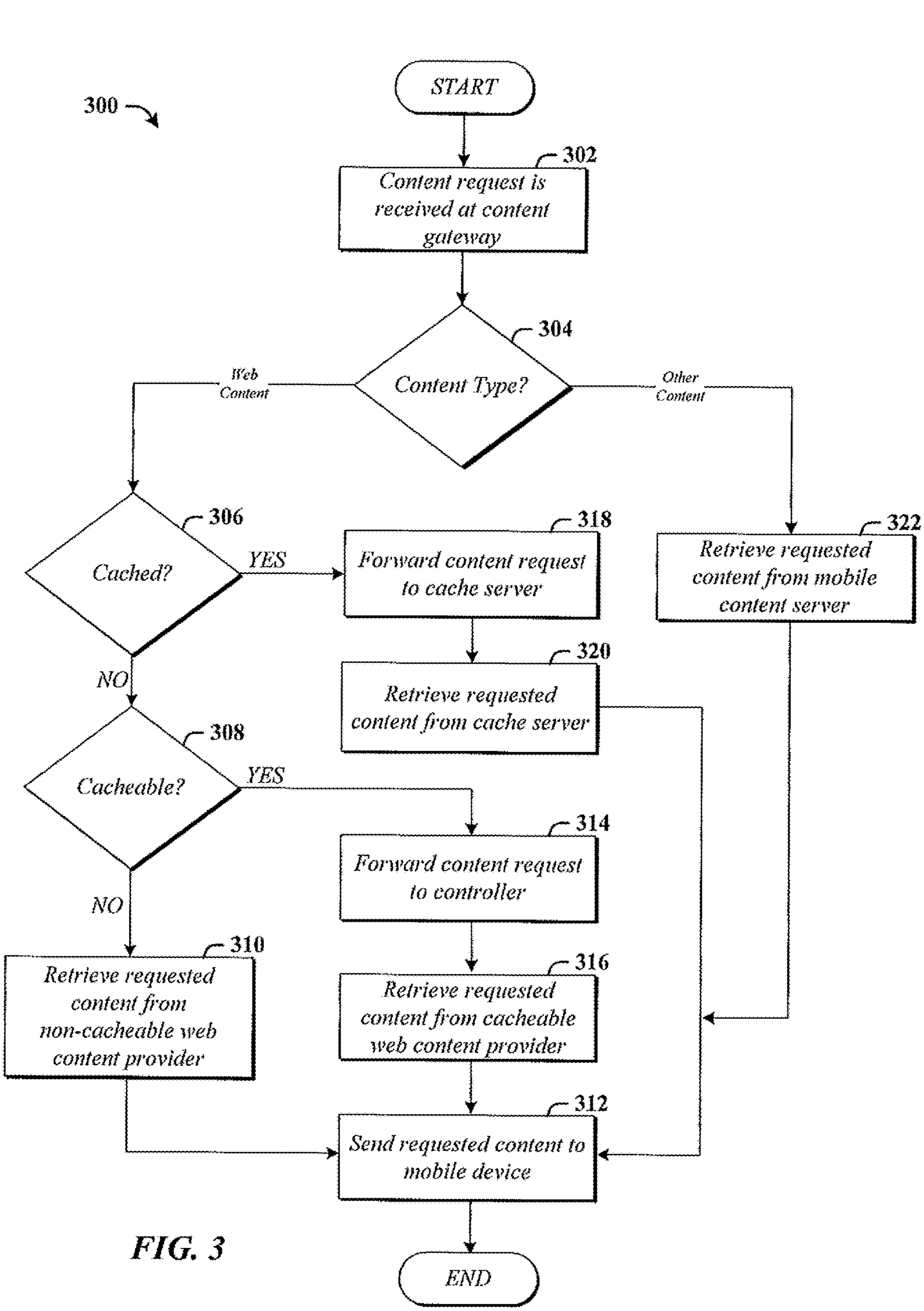

300
START
302
Content request is received at content gateway
304
Content Type?
Web Content
Other Content
306
Cached?
YES
318
Forward content request to cache server
322
Retrieve requested content from mobile content server
NO
320
Retrieve requested content from cache server
308
Cacheable?
YES
314
Forward content request to controller
NO
310
Retrieve requested content from non-cacheable web content provider
316
Retrieve requested content from cacheable web content provider
312
Send requested content to mobile device
END

FIG. 3

CONTENT ENGINE FOR MOBILE COMMUNICATIONS SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to and is a continuation of U.S. application Ser. No. 15/045,885, filed Feb. 17, 2016, which is a continuation of U.S. application Ser. No. 12/791,414, filed Jun. 1, 2010, now U.S. Pat. No. 9,270,775, which is a continuation of U.S. application Ser. No. 11/752,199, filed May 22, 2007, now U.S. Pat. No. 7,756,130, each of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

The present invention relates generally to content provisioning. More particularly, the present invention relates to content provisioning via an intra-network content engine in a wireless communications network.

BACKGROUND OF THE INVENTION

The recent deployment of 3G networks has made a wide array of content types available to wireless subscribers. Multimedia content, such as music, games, and movies, and content rich websites and web applications, create an abundance of network traffic between a content provider residing outside of the wireless operator's network and the core and access subsystems of the network. The interfaces used for communication between the external content providers and the operator's network are inefficient and incapable of providing end-to-end quality of service (QoS) for content requests. As such, the operator's network is used as an intermediary to deliver content to subscribers. This places an inordinate amount of traffic load on the network systems. Moreover, the need to send and resend the same content for multiple subscribers places additional strain on network resources.

In addition, external content providers target general users and cannot properly consider and adapt content to a format conducive to mobile devices in general, let alone a format configured specifically for a particular mobile device.

Thus, what is needed are new systems and novel methods to optimize content provisioning to mobile subscribers, to minimize the amount of data traversing the operator's network at any given time and, to increase the overall system response time. As will be seen by the following description, such new systems and novel methods allow mobile subscribers to experience less latency, better QoS, and increased throughput, resulting in better content presentation. Wireless operators can also benefit by reduced expense associated with less redundant capacity, simpler operation and easier maintenance associated with the present invention, as well as becoming the true content provider instead of an intermediary. Content providers also benefit from increased usage of their content.

SUMMARY OF THE INVENTION

The aforementioned deficiencies are overcome by providing an intra-network content engine for processing content requests from a plurality of mobile devices. An exemplary intra-network content engine includes a content gateway configured to analyze and route content requests to a content server. The content server can be a cache server or a mobile content server. The cache server can be configured to receive and store cacheable web content from a controller that is configured to receive the cacheable web content from at least one cacheable web content provider, such as a web server, and route the content to the cache server. The mobile content server can be configured to receive and store the digital media content. The controller can be further configured to receive the digital media content from at least one external content server and route the content to the mobile content server. The content gateway can be further configured to receive non-cacheable web content from at least one non-cacheable web content provider.

An exemplary method for content provisioning via the intra-network content engine includes the steps of receiving a content request; analyzing the content request to determine to which content server the content request should be routed, wherein the content server is one of a cache server and a mobile content server; routing the content request to the cache server, if the requested content is cacheable web content; routing the content request to the mobile content server, if the requested content is digital media content; routing the content request to a non-cacheable web content provider, if the requested content is non-cacheable web content; retrieving the requested content from the appropriate source; and sending the requested content to the requesting mobile device.

A computer-readable medium that includes computer-executable instructions which, when executed, perform the steps of the foregoing method is also provided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an exemplary communications system in accordance with an embodiment of the present invention.

FIG. **2** illustrates an exemplary content engine in accordance with an embodiment of the present invention.

FIG. **3** illustrates an exemplary methodology for processing a content request by the exemplary content engine of FIG. **2**, according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As required, detailed embodiments of the present invention are disclosed herein. It must be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms, and combinations thereof. As used herein, the word "exemplary" is used expansively to refer to embodiments that serve as an illustration, specimen, model or pattern. The figures are not necessarily to scale and some features may be exaggerated or minimized to show details of particular components. In other instances, well-known components, systems, materials or methods have not been described in detail in order to avoid obscuring the present invention. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention.

Referring now to the drawings wherein like numerals represent like elements throughout the several views, FIG. **1** illustrates a communications network **100** in which the present invention may be implemented. Multiple access network types may be used to access content provided by a content engine **102** in accordance with various embodiments of the present invention. By way of example and not

limitation, the illustrated access network types include a GSM/EDGE Radio Access Network (GERAN) **104**, a UMTS Terrestrial RAN (UTRAN) **106**, a Wireless LAN access system (WLAN) **108**, and a Long term Evolution access (LTE) system **110**. Corresponding mobile devices **112** are illustrated as being in communication with the various access networks.

The GERAN **104** and UTRAN **106** are illustrated as being in communication with a GPRS core network **114** that may be further configured with an inter-network function **116** to facilitate communication with the WLAN **108**. The WLAN **108** is also in communication with a System Architecture Evolution (SAE) core **118** that in turn in communication with an IMS (IP Multimedia Subsystem) core **120** and the LTE access system **110**. The IMS core **120** is also in communication with the GPRS core network **114**.

The GPRS core network **114**, IMS core **120** and SAE core **118** are each in communication with one or more corporate content servers **122**. A corporate content server **122** can provide operator-originated content; that is, content that does not originate from an external content provider. For example, proprietary ringtones, music files, videos and the like may be provided by a corporate content server **122**. Although illustrated as a separate network element, the corporate content server(s) **122** may be included in the content engine **102**.

The GPRS core network **114** and SAE core **118** are also in communication with the content engine **102** that in turn is in communication, via a firewall **124**, with external content providers **126**. As illustrated, the external content providers **126** can provide non-cacheable and cacheable web content, such as websites and web applications, and other content. Other content can include digital media content, for example, e-books, ringtones, ringback tones, music files, video files, movies, video games, news feeds (e.g., via RSS (Real Simple Syndication)), sports score feeds, weather, and other content made available via one or more external content providers.

The content engine **102** is also in communication with other non-3GPP systems **132**, in which the present invention may also be practiced. The content engine **102** is now described below with reference to FIG. **2**.

FIG. **2** illustrates a content engine **102** in accordance with an exemplary embodiment of the present invention. The illustrated content engine **102** includes a controller **200**, a cache server **202**, a content format modifier **204**, a content gateway **206**, and a mobile content server **208**. The functionality of each of these elements is described below in detail.

The controller **200** provides gateway functionality to content provisioning systems, such as the external content providers **126**. The controller **200** may include the firewall **124** and may perform filtering functions in accordance with filtering parameters determined by the operator. The controller **200** is also configured to route content within the engine to the appropriate processing components.

To the external content providers **126**, the controller **200** performs client functions to cache websites and load content. In certain implementations, it may be beneficial to provide formatted content for a mobile device type or specific device configuration. In these implementations, the controller **200** can route content to the content format modifier **204** for reformatting content to adhere to specifications of the requesting mobile device. Afterwards, the reformatted content can be sent to the mobile content server **208** and stored. Content that does not need to be reformatted can be sent directly to the mobile content server **208**.

For cacheable websites, the controller **200** forwards the content to the cache server **202** to be cached. From the mobile device perspective, the controller **200** may be invisible and the content provided to the mobile device may be presented as it would if the content was delivered directly from the original content provider.

Web content that is updated or refreshed may be done so automatically or based upon a schedule maintained by the controller or the cache server. These setting may be configured by the operator or by the client device.

The cache server **202** is configured to function as a website server for cacheable web content. Cacheable content is received by the controller **200** and forwarded to the cache server **202** for storage. The cache server **202** provides pre-caching of web content in an effort to reduce latency and improve access time for the mobile devices **112**.

The content gateway **206** may be configured to determine if incoming content should or should not be cached. By way of example, content sent from virtual private networks (VPN), such as in many enterprise applications, are not cacheable. Private data, such as that exchanged in web sessions with bank accounts or personal email accounts are other examples of non-cacheable content.

In one embodiment, the content gateway **206** can be configured to store and maintain a lookup table of the current cache in the cache server **202**. Likewise, the cache server **202** may be configured to send updates to the content gateway **206** on an as-needed or periodic basis to update the lookup table. The content gateway **206** may also store a record of all content requests and may itself request that specific websites be cached; for example, if access to a website exceeds a pre-determined threshold value, then a request may be sent to the cache server requesting that the website be cached for future use. Either or both of the content gateway **206** and the cache server **202** may be configured with a plurality of rules to determine if a website is cacheable and if a website needs to be cached, based upon previous usage data, for example. Generally, the caching rules can be developed based upon the business needs of the mobile operator.

The mobile content server **208** is the digital media content server to the network subscribers. The digital media content received from the external content providers is formatted (if necessary) and readied to be sent to the mobile device **112** via the content gateway **206** upon request. Maintaining all content within the operator's network as opposed to the operator substituting as an intermediary between the end user and the content provider allows the mobile operator to provide content with less latency, better QoS, and increased throughput, resulting in better content presentation.

The content gateway **206** provides an interface to the packet core network. For 3GPP applications, such as the illustrated embodiment, the Gi interface is used. The content gateway **206** receives requests from mobile devices and routes the request to the mobile content server **208** for content such as ringtone, music, or videos. For cacheable content, the requests are routed to the cache server **202**. The content gateway **206** also routes the requested content to the mobile devices **112** from these elements.

The content gateway **206** may also be configured with firewall and/or filtering functions to reduce potential contamination of the content being exchanged between the content engine **102** and the mobile devices **112**, and to reduce the likelihood of a security breach.

The content gateway **206** may be further configured to steer traffic by maintaining an index of all available websites, applications, and individual content currently or sched-

uled to be available from the cache server **202** and/or mobile content server **208**. Lookup tables for the cache server **202** and/or the mobile content server **208** may provide this information. The lookup tables may be updated by the host server (i.e., either the cache server **202** or the mobile content server **208**) via periodic updates or as-needed.

Service management functions **210** and administrative functions **212** are also in communication with the content engine **102**. Service management functions can include, but are not limited to, maintaining licensing agreements for copyright protected content. Administrative functions **212** can include content engine **102** software, hardware, or firmware upgrades, and account management features, such as account creation, account closure, and communication with the operator's billing system to bill for billable content.

Referring now to FIG. **3**, a flow diagram of an exemplary method for provisioning content via an inter-network content engine, such as content engine **202**, is illustrated. The method **300** begins and proceeds to step **302** wherein a content request is received at the content gateway **206**. The content gateway **206** can determine, based upon information in the content request, the type of content that is being requested. More particularly, whether the content is web content, or other content, such as a digital media content. This determination is illustrated as step **304**.

If it is determined that the content is web content, flow proceeds to step **306** wherein a determination is made as to whether the web content is cached. If the content is not cached, flow proceeds to step **308** wherein a determination is made as to whether the web content is cacheable. This determination may be made by processing the request in accordance with a plurality of rules to determine if the content is cacheable. Moreover, historical data such as provided by lookup table records may be used to aid in this determination.

If it is determined that the content is not cacheable, flow proceeds to step **310** wherein the requested content is retrieved from the external content provider **126** associated with the requested content. For example, the external content provider **126** may be a bank account server that contains personal data that should not be cached. The content gateway **206** then sends the requested content to the requesting mobile device **112** at step **312**. If, however, it is determined that the content is cacheable, the content gateway **206** forwards the content request to the controller **200** at step **314**. The controller **200** can then retrieve the content and send the content to the content gateway **206** at step **316**. The content gateway **206** can forward the content to the requesting mobile device **112** at step **312**.

If the content is cached, as determined in step **306**, the content gateway **206** can forward the content request to the cache server **202** at step **318**. The content gateway **206** receives the content from the cache server **202** at step **320** and forwards the content to the requesting mobile device **112** at step **312**.

If it is determined at step **304** that the content request type is for other content, the flow proceeds to step **322** and the content gateway **206** retrieves the requested content from the mobile content server **208**. The request may include a device type or other device specifications for which the requested content is to be formatted. By way of example and not limitation, this information may be provided via an International Mobile Equipment Identity (IMEI) or by at least one of the make, model, and revision of the mobile device. The mobile content server **208** may be configured to store a plurality of different configurations for the stored content, such as the most often used format types. In this embodiment, the mobile content server **208** could retrieve the appropriately formatted content and return it to the content gateway **206**. The content gateway **206** then forwards the content to the requesting mobile device **112** at step **312**.

The law does not require and it is economically prohibitive to illustrate and teach every possible embodiment of the present claims. Hence, the above-described embodiments are merely exemplary illustrations of implementations set forth for a clear understanding of the principles of the invention. Variations, modifications, and combinations may be made to the above-described embodiments without departing from the scope of the claims. All such variations, modifications, and combinations are included herein by the scope of this disclosure and the following claims.

What is claimed is:

1. A system, comprising:

a memory that stores instructions;

a processor that executes the instructions to perform operations, the operations comprising:

retrieving content in response to a request for content received from a device;

modifying, based on a characteristic of the device, the content to create modified content customized for the device;

transmitting, to the device and based on a time when the modified content is scheduled to be available, the modified content customized for the device;

determining a most often used format type for the content; and

storing a configuration of the content corresponding to the most often used format type for the content.

2. The system of claim **1**, wherein the characteristic of the device comprises a hardware component, a software component, or a firmware component of the device.

3. The system of claim **1**, wherein the transmitting of the content further comprises transmitting the modified content to the device based on an index of content that indicates the time when the modified content is scheduled to be available.

4. The system of claim **1**, wherein the transmitting of the content is facilitated by a controller invisible to the device.

5. The system of claim **4**, wherein the transmitting of the content further comprises transmitting the modified content to the device by the controller to appear as if the modified content is delivered directly from an original content provider instead of the controller.

6. The system of claim **1**, wherein the operations further comprise reducing a potential contamination of the content by utilizing a filtering function.

7. The system of claim **1**, wherein the operations further comprise storing a plurality of different configurations for the content.

8. The system of claim **1**, wherein the operations further comprise determining if the content is cached.

9. The system of claim **1**, wherein the operations further comprise determining if the content is cacheable.

10. The system of claim **9**, wherein the operations further comprise retrieving the content from an external content provider if the content is not cacheable.

11. The system of claim **1**, wherein the operations further comprise determining, based on the request, a type of the content.

12. The system of claim **1**, wherein the operations further comprise identifying a type of the device.

13. The system of claim **1**, wherein the operations further comprise maintaining a lookup table of a current cache.

14. A method, comprising:

obtaining content in response to a request for content received from a device;

modifying, based on a characteristic of the device and by utilizing instructions from a memory that are executed by a processor, the content to create modified content customized for the device;

providing, to the device and based on a time when the modified content is scheduled to be available, the modified content customized for the device;

determining a most often used format type for the content; and

caching a configuration of the content corresponding to the most often used format type for the content.

15. The method of claim 14, further comprising reducing a potential contamination of the content by utilizing a firewall function.

16. The method of claim 14, further comprising updating the content based on a schedule.

17. The method of claim 14, further comprising determining if access to the content has exceeded a threshold value.

18. The method of claim 17, further comprising caching the content if the access to the content has exceeded the threshold value.

19. The method of claim 14, further comprising transmitting the modified content to the device based on an index of content.

20. A non-transitory computer-readable medium of a content engine comprising computer-executable instructions, which, when loaded and executed by a processor, cause the processor to perform operations, the operations comprising:

obtaining content in response to a request for content received from a device;

altering, based on a characteristic of the device, the content to create modified content customized for the device;

providing, to the device and based on a time when the modified content is scheduled to be available, the modified content customized for the device;

determining a most often used format type for the content; and

storing a configuration of the content corresponding to the most often used format type for the content.

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